SPAWAR Systems Center PACIFIC

Space and Naval Warfare Systems Center Pacific (SSC Pacific)

# ROBOTICS UPDATE

"Providing network-integrated robotic solutions for C4ISR applications."

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## James Cruickshanks Named Chief Engineer for Integrated Base Defense

On 15 May 2012, SSC Pacific's James Cruickshanks was named Chief Engineer for Integrated Base Defense (IBD) within the Joint Project Manager (JPM) Guardian organization. In this capacity, he is responsible for the establishment and oversight of technical Integrated Product Teams (IPTs) that will facilitate the transition of Science and Technology (S&T) efforts to IBD.

JPM Guardian, which serves Army and Joint stakeholders as the single point of contact for IBD capabilities, was designated by the Assistant Secretary of the Army (Acquisition Logistics and Technology) to lead the synchronization and coordination of IBD activities across the Program Executive Offices and combatant commands.

For the past 7 years, James has worked with SSC Pacific in force protection, with project experience that includes: 1) *Family of Integrated Rapid Response Equipment (FIRRE)*, 2) *Force Protection Joint Exercise (FPJE),* 3) *Joint Force Protection Advanced Security System (JFPASS)* Lead Systems Engineer, and 4) *Joint Battlespace Command and Control System (JBC2S)* development management in support of *FIRRE, FPJE, Entry Control Point (ECP), Counter-Personnel Borne Improvised Explosive Device (C-PBIED),* and *Deployable Force Protection (DFP).*

Through these projects, James has spearheaded the advancement of IBD command-and-control (C2) software that leverages sophisticated fusion, automation and integration (FAI) techniques. FAI incorporates multiple ground sensors, radars, cameras, operator stations, warning devices and manned/unmanned response units into a single integrated C2 system. This vendor-neutral solution merges disparate COTS/GOTS force-protection systems through the use of standards established by the Physical Security Equipment Action Group within OSD. This capability reduces troop-to-task, increases situational awareness, and decreases response time.

Joint Battlespace Command and Control System (JBC2S) and unmanned force-protection assets at Joint Force Protection Advanced Security System (JFPASS) Operational Demonstration.

Combat Outpost Surveillance & Force Protection System (COSFPS) overview briefing with other integration partners at Fort A.P. Hill, Sprung Building, July 2012.

The key behind these advancements is an open services-orientated modular architecture that has demonstrated the ability to scale from small expeditionary bases to large fixed installations. The joint experimental activities and CENTCOM deployments listed previously have matured the software to the point where James championed the establishment of a software support activity (SSA) at SSC Pacific to provide management for JPM Guardian customers. Leveraging SSC Pacific's corporate expertise in fielding maritime C2, the SSA activities are being led by Randy Arrasmith from the Command and Control Department.

James earned both his bachelor of engineering in mechanical engineering (BEME) and master of engineering in mechanical engineering (MEME) from The Cooper Union for the Advancement of Science and Art in 2002 and 2004, respectively. Additionally, he is a certified Project Management Professional (PMP) and DAWIA Level III Systems Engineer.

# SSC PACIFIC Engineers Present at SPIE Conference

A virtual robot with adaptive camouflaging in various simulated environments. An image taken from the robot's virtual camera was used by the real-texture-synthesis algorithm to produce the camouflage pattern displayed on the exterior surface of the robot.

The Society for Optics and Photonics event in Baltimore, MD, this past April was the largest in "Defense, Security, and Sensing" history, with 6700 registered attendees, 2450 technical presentations, 540 exhibitors on the show floor, and an 18-percent increase in exhibit attendees. In the "Early Stage Technology Commercialization Workshop" moderated by Joseph Montemarano (Executive Director, Princeton University), panelists from US government laboratories, the venture-capital community, and industry discussed ways to speed the commercialization and deployment of early-stage Defense and Homeland Security applications. Nearly 150 attendees listened to a panel of influential government officials discuss ways to assist industry in determining potentially profitable areas of investment to develop technology of interest to government funding agencies.

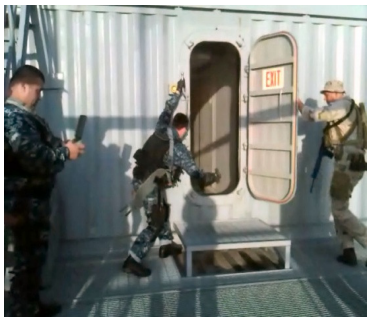
SPAWAR Systems Center Pacific was well represented with five presentations covering a diverse set of topics. "Mesh Networking Optimized for Robotic Teleoperation," presented by Abe Hart, discussed how implementation of mesh networks for robotic teleoperation poses different challenges than those associated with traditional mesh networks. Mobile unmanned ground vehicles operate in constantly changing environments, and building a mesh network to work well under such harsh conditions presents several unique challenges. These problems are being addressed by SSC Pacific via the *Manually Deployed Communication Relay* mesh networking system, which extends the range and provides non-line-of-sight communications for tactical and explosive ordnance disposal (EOD) robots currently in theater. This system supports multiple mesh nodes, robots acting as nodes, and works with all Internet Protocol (IP)-based robotic systems.

Presented by Hoa Nguyen, "Characteristics of a Maritime Interdiction Operations Unmanned Ground Vehicle" discussed the need for a small tactical robot that can be deployed ahead of Navy teams to provide enhanced situational awareness in boarding, breaching, and clearing operations. SSC Pacific performed a market survey, identified and obtained a number of throwable robots, then evaluated each of these candidates in realistic training environments.

"Adaptive Electronic Camouflage Using Texture Synthesis," presented by Narek Pezeshkian, described how the outer surface of a robot or a leave-behind sensor can automatically change in color and pattern to match the surrounding environment. Biologically-inspired adaptive camouflage can be achieved by taking an image of the local environment with the robot's onboard camera, synthesizing a statistically equivalent texture image, and displaying the synthesized image on exterior display panels that shroud the device. The focus of this paper was on the work performed for the first two steps of the process. Color-camouflage-synthesis is accomplished by modifying a texture synthesis method that uses gray-level co-occurrence matrices. Statistic equality in color-proportion is achieved with the use of conditional probability constraints.

"Evolution of a Common Controller," presented by Darren Powell, discussed how the latest version of the *Multi-robot Operator Control Unit (MOCU)* addresses interoperability, standardization, and customization issues through a modular, extensible, and flexible architecture built upon a shared world model. *MOCU* version 3 provides an open and extensible operator-control interface that allows additional functionality to be seamlessly added in the form of software modules, while providing the means to fully integrate the information into a layered game-like user interface. The design allows *MOCU* to completely decouple the human interface from the core management modules, while still enabling modules to render overlapping regions of the screen without interference or *a priori* knowledge of other display elements. This approach allows more flexibility in project-specific customization.

"Development and Demonstration of Autonomous Behaviors for Urban Environment Exploration," presented by Alexander Xydes, described SSC Pacific's extension of our navigation and localization capabilities to include mapping of multiple multi-story buildings. Autonomous robots can now detect stairs/stairwells, maintain localization across dissimilar environments (e.g., in a 3D world, on stairs, with/without GPS), visualize data in 3D, plan paths between any two points within the specified area, and avoid obstacles. These technologies have been developed as independent behaviors under our *Autonomous Capabilities Suite (ACS)* architecture, and recently demonstrated at a MOUT site at Camp Pendleton.



Typical deployment mode for VBSS robots.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